Low Cost ECG Monitor for Developing Countries

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***Abstract*- Cardiovascular disease (CSD) will become the leading cause of death worldwide by the year 2010. To help doctors in developing countries make an accurate diagnosis even in the most remote of locations, an electrocardiogram (ECG) of low cost has been built and fully tested. Many hospitals in developing countries cannot afford the price for a commercial grade ECG, however there has been a unprecedented increase in the number of mobile phone subscribers in the developing world which has seen mobile phones used in ways not seen in the developed world. Mobile phones can be used to display the patient's ECG, thus dramatically reducing the cost. This project aims to design and construct at least two of the four main components in a basic modern ECG data logging system – the patient's electrodes and the amplifier. Special firmware will be written which would pass the ECG signals to the mobile phone as a digital stream through the phone's USB port. Finally, software will be written for the phone to display the ECG signals on the phone's screen.**

BACKGROUND

The complete ECG data logging system is shown in Fig. 1. The three electrodes on the patient are made from scrap galvanised iron and straps of worn rubber from a wheel of a bicycle. The two op-amp low noise instrumentation amplifier of high gain (> 1000) and 50 Hz active twin-T notch filter to remove noise from the mains were built together on the same PCB. Protection from voltage surges was achieved using back to back diodes at the input to the amplifier. The MCF51JM128 microcontroller from Freescale semiconductor was configured as a USB host controller and used to send the ECG signals to the PDA. The PDA runs a program in Visual C++ to capture and display the signals through one of its COM ports.

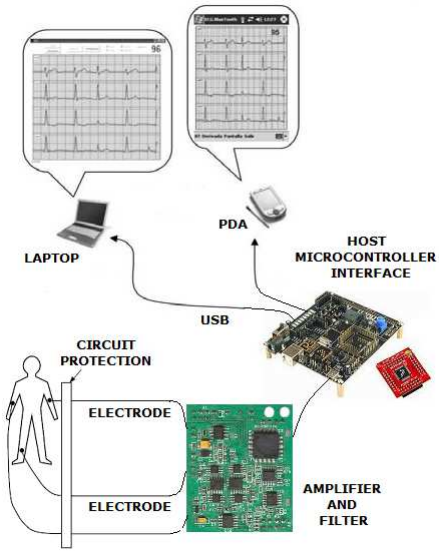

Fig. 1. The ECG System

CURRENT RESULTS

Fig. 2 shows the authors' type II ECG signals after amplification and filtering. The ECG signals have features which are consistent with theory [1], including the heart rate, R peak magnitudes, Q-T interval and the overall PQRST shape.

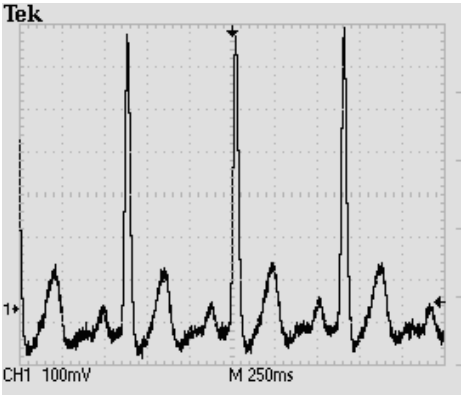

Fig. 2. Type II ECG Signals

Table I shows that the amplifier component costs in bulk (500+) total less than five Australian dollars from Farnell, and together with the MCF51JM128 processor costing only a couple of dollars more, it can be concluded that the project is feasible for deployment in developing countries [2].

TABLE I
BILL OF MATERIALS – COMPONENT LIST FOR ECG AMPLIFIER

Quantity	Description	Unit Price (AUS$)	Total Cost (AUS$)
1	TL074CD SOIC IC	0.40	0.40
1	BC 847 SOT23 BJT	0.03	0.03
1	MBF4416 SOT23 FET	0.30	0.30
11	SMD Resistors	0.05	0.55
7	1N4148 DO-35 Diodes	0.02	0.14
7	SMD Capacitors	0.02	0.14
4	0.5 W Trimmers	0.50	2.00
1	9V PP3 Battery	0.70	0.70
1	9V PP3 Battery Clip	0.50	0.50
Total Project Cost (AUS$)			4.76

REFERENCES

[1] Y. F. Low, I. B. Mustaffa, N. B. M. Saad, and A. H. Bin Hamidon, "Development of PC-Based ECG Monitoring System," *IEEE 4th Student Conference on Research and Development*, pp. 66–69, June 2006.

[2] B. Bermani, B. Dandekar, and P. Ingemi, "EvalECG : Low Cost ECG Tester," Worcester Polytechnic Institute, Worcester, MA, ECE 2799 Technical Report, 2004.

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